REMARKS

The following claims are pending in the application: 1 - 29

The following claims have been amended: 1, 11, 15, 21, 25, and 29

The following claims have been deleted: 26

The following claims have been added: None

As a result of the foregoing Amendment, the following claims remain pending in the application: 1 through 25, 27 - 29.

The Rejection Under 35 U.S.C. §102(b)

The Examiner has rejected claims 1 through 5, 8 through 25, and 27 through 29 under 35 U.S.C. §102(b) as being anticipated by De Castro et al. (U.S. Pat. No. 5,841,021). With regard to claim 1, the Examiner takes the position that De Castro et al. teaches the claimed sensor comprising a substrate, a first electrode, a second electrode, and a sensing material that is selected to absorb certain predetermined contaminants such as carbon monoxide, carbon dioxide, oxides of nitrogen, oxides of sulfur, hydrides of nitrogen such as ammonia, primary and secondary amines and hydrazine, hydrogen sulfide, hydrogen, methanol and ethanol, toxic or flammable gases as of a reducing stream, to provide an electrical voltage signal indicating the amounts or levels of gas concentration being detected.

Applicants have amended claim 1 to more accurately reflect the selective detection of carbon monoxide achieved by the inventive sensor. That is, the sensor of the present invention can detect carbon monoxide even in the presence of hydrogen or other reducing gases because of the selectivity provided by the sensing material used therein.

This selectivity permits the inventive sensor to detect carbon monoxide without responding to other gases present in the gas steam such as hydrogen gas. The Examiner's attention is respectfully directed to Figures 7 and 8 wherein the selectivity of the inventive sensor is demonstrated. Figure 7 shows the carbon monoxide sensitivity of the inventive sensor in the presence of hydrogen gas. As disclosed on page 13, lines 1 - 2, the hydrogen content was varied between 25 and 75 percent without a change in the baseline. This indicates that the inventive sensor is insensitive to the presence of hydrogen and that the signal generated by the sensor is the result of the presence of carbon monoxide alone. Figure 8 shows the sensor's ability to detect different levels of carbon monoxide in a nitrogen-hydrogen environment. Reference numerals 82, 84, and 86 indicate the injection of 500, 1000, and 1500 ppm (respectively) of carbon monoxide.

De Castro et al. teaches a sensor having a catalytic and a reference electrode disposed on an ionically conductive substrate. Col. 9, lines 22 - 25. De Castro et al. further teaches that the catalytic electrode and the reference electrode are constructed of different materials thereby producing a potential difference between the electrodes when the sensor is subjected to a gas sample containing contaminant gases. Col. 9, lines 22 - 28. De Castro further teaches a wide variety of gases that his sensor can detect *including hydrogen*. Col. 6, lines 36 - 52. A key aspect of the De Castro et al. sensor is that only the catalytic electrode responds to the contaminant gas in the gas sample while the reference electrode remains inert and substantially unresponsive. Col. 9, line 29 - 32. Thus, the De Castro et al. sensor is a potentiometric device that generates a signal in response to the interaction of the contaminant gas with the catalytic electrode. In simplest terms, the elements of De Castro's sensor are arranged as follows: catalytic

electrode in electrical communication with an ionically conductive substrate that is in electric communication with a reference electrode. Thus, the sensing element (the catalytic electrode) is in electric communication with only one other element, the ionically conductive substrate.

The present invention is different from the De Castro disclosure because the sensing material is selective to carbon monoxide. That is, the sensing material of the inventive sensor only detects carbon monoxide. It does not care what the background gases are. This is important because a sensor like De Castro that is sensitive to hydrogen would yield a cumulative signal when exposed to carbon monoxide and hydrogen. However, there would be no way to know what percentage of the signal is attributable to which gas. Further, the present invention is different from the De Castro disclosure in that the sensing material is between the two electrodes. Furthermore, the substrate of the present invention is non-conductive, unlike the ionically conductive substrate of the De Castro reference. Additionally, neither electrode of the present invention is reactive to a contaminant gas as is the catalytic electrode of the De Castro reference. As De Castro fails to teach each and every element as set forth in the claim (either expressly or inherently), the reference cannot fairly be said to anticipate the present invention. *See* Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). Accordingly, Applicants respectfully submit that the Examiner's outstanding rejection may be properly withdrawn.

Regarding claim 2, the Examiner takes the position that De Castro et al. teaches that the substrate is alumina.

Applicants note that claim 1, from which claim 2 depends has been differentiated above and that those arguments are applicable here as well. Applicants respectfully submit that the Examiner has not fully appreciated the teachings of the De Castro reference regarding alumina. De Castro teaches, as an alternative embodiment, the addition of two layers of filter material to restrict, reject, remove, or chemically react with interfering gases that may generate a signal and lead to error in the sensor. Column 15, lines 14 - 41. While De Castro does teach that the filter layer may comprise alumina, the filter layer is in addition to, not as a replacement for, the substrate. See Figure 11 of De Castro, especially reference characters 48A and 16. Thus, De Castro never teaches that the substrate may be constructed of alumina. Accordingly, in light of the differentiation of the De Castro reference as to claim 1above and the misunderstanding with respect to De Castro's disclosure of alumina, Applicants respectfully submit that the Examiner's rejection of claim 2 may be properly withdrawn.

Regarding claim 3, the Examiner takes the position that De Castro et al. teaches that the first electrode is an interdigital electrode. Regarding claim 4, the Examiner takes the position that De Castro et al. teaches that the second electrode is an interdigital electrode.

Applicants note that claim 1, from which claims 3 and 4 depend have been differentiated above and that those arguments are applicable here as well.Applicants respectfully submit that the Examiner has failed to appreciate exactly what an interdigital electrode is as used in the present invention. The Examiner's attention is respectfully directed to Figure 3 of the present application, wherein a pair of interdigital electrodes are shown **34**, **35**. The Examiner's rejection appears to be based on De Castro's disclosure

that the voltage output from the sensor and reference electrodes 12 and 14 can be changed to a first digital input and operated on by a computer. See Col. 12, lines 20 - 30. Digital, as used in this passage, refers to the use of binary code for entry into a computer, that is a binary code. De Castro's use of "digital" is unrelated to the "interdigital electrodes" used in the present invention. De Castro fails to teach interdigital electrodes as shown in Figure 3 of the present application. Accordingly, the Examiner's outstanding rejections of claims 3 and 4 may be properly withdrawn.

Regarding claim 5, the Examiner takes the position that De Castro et al. teaches that the sensing material is a halide. Applicants note that claim 1, from which claim 5 depends has been differentiated above and that those arguments are applicable here as well. Applicants respectfully submit that De Castro fails to teach that the sensing material is a halide at Col. 10, lines 22 - 67. Rather, De Castro teaches that the reference electrode may be constructed from any stable, non-interfering redox couple such as a metal halide. Accordingly, De Castro cannot fairly be said to teach a halide sensing material when the reference clearly teaches that any halide used is to be non-interfering. Thus, Applicants respectfully submit that the Examiner's outstanding rejection may be properly withdrawn.

Regarding claim 8, the Examiner takes the position that De Castro et al. teaches that the sensor is heated by a temperature compensator electrode. Applicants note that claim 1, from which claim 8 depends has been differentiated above and that those arguments are applicable here as well. Thus, Applicants respectfully submit that the Examiner's outstanding rejection may be properly withdrawn.

Regarding claim 9, the Examiner takes the position that all of the claimed subject matters are in claim 8 above. Applicants note that claim 1, from which claim 9 depends has been differentiated above and that those arguments are applicable here as well. Thus, Applicants respectfully submit that the Examiner's outstanding rejection may be properly withdrawn.

Regarding claim 10, the Examiner takes the position that De Castro et al. teaches the claimed electrical property - voltage. Applicants note that claim 1, from which claim 10 depends has been differentiated above and that those arguments are applicable here as well. Thus, Applicants respectfully submit that the Examiner's outstanding rejection may be properly withdrawn.

Regarding claim 11, the Examiner takes the position that De Castro et al. teaches all of the claimed subject matter in claim 1 above and including H_2.

Applicants respectfully submit that claim 11 provides a method for using a sensor of the present invention to determine a concentration of carbon monoxide in a hydrogen containing (reducing) gas stream. Applicants submit that the novelty of the inventive sensor is its ability to detect carbon monoxide without detecting hydrogen. Applicants further submit that the novelty of the inventive sensor has been discussed in depth above and that the method of claim 11 relies upon the structure of the inventive sensor. Accordingly, Applicants respectfully submit that a method of using the new sensor cannot be anticipated by the disclosure of a method directed towards the use of a different sensor. Therefore, Applicants respectfully submit that the Examiner's outstanding rejection may be properly withdrawn.

Regarding claims 12, 13, and 14, the Examiner takes the position that all of the claimed subject matters are in claims 11 above. Applicants respectfully submit that these three claims depend from independent claim 11 that has been differentiated from the teachings of the De Castro reference above. Accordingly, Applicants respectfully submit that the Examiner's outstanding rejection of claims 12, 13, and 14 may be properly withdrawn.

Regarding claim 15, the Examiner takes the position that all of the claimed subject matter is cited in claim 1 above as the multi-layer or multifunction gas sensor and the oxidized agent.

Claim 15 is directed to a method for sensing a concentration of carbon monoxide while converting a hydrocarbon fuel into a gas stream. Similar to claim 11, claim 15 is restricted by the particular structure of the inventive sensor. Therefore, the De Castro reference cannot fairly be said to anticipate a method of using a new sensor. Accordingly, the Examiner's outstanding rejection of claim 15 may be properly withdrawn.

Regarding claims 16 through 24, the Examiner takes the position that all of the claimed subject matters are cited in claims 15 above. Applicants respectfully submit that claims 16 through 24 depend from independent claim 15. As claim 15 has been differentiated from the De Castro reference, dependent claims 16 through 24 cannot fairly be said to be anticipated by the reference either. Accordingly, the Examiner's outstanding rejection of claims 16 through 24 may properly be withdrawn.

Regarding claim 25, the Examiner takes the position that all of the claimed subject matter is cited in claims 1 and 5 above. Applicants have amended claim 25 to include the

limitation of claim 26. Accordingly, Applicants respectfully submit that claim 25 cannot be anticipated by De Castro as that reference fails to teach the use of cuprous chloride.

Regarding claims 27 and 28, the Examiner takes the position that all of the claimed subject matter is cited in claims 10 and 25 above. Applicants respectfully submit that claims 27 and 28 are not anticipated by De Castro in light of the amendment to claim 25.

Regarding claim 29, the Examiner takes the position that all of the claimed subject matter is cited in claim 1 above, and including the conduits.

Applicants respectfully submit that De Castro fails to teach each and every element of the claimed invention. Specifically, De Castro fails to teach a sensing material in electrical contact with a first and a second electrode wherein an electrical property of the sensing material varies in relation to the quantity of absorbed carbon monoxide on the sensing material. Accordingly, as De Castro fails to teach each and every element of claim 29, the reference cannot fairly be said to anticipate the present invention. Therefore, the Examiner's outstanding rejection may be properly withdrawn.

The Rejection Under 35 U.S.C. §103(a)

The Examiner has rejected claims 6, 7, and 26 under 35 U.S.C. §103(a) as being unpatentable over De Castro et al. in view of Tamaki et al. The Examiner takes the position that De Castro fails to disclose the sensing material is cuprous chloride. However, the Examiner takes the position that De Castro teaches an electrochemical gas sensor for sensing/testing a plurality of different gases and volatile substances as diverse as carbon monoxide, carbon dioxide, oxides of nitrogen, oxides of sulfur, hydrides of

nitrogen, and hydrogen sulfide. Further, De Castro allegedly teaches electrodes and a sensor coated with sensing materials such as metal halide to provide electrical voltage signals indicating the amounts of levels of gas concentration being detected. Tamaki et al. suggests an anhydrous zinc antimonate semiconductor gas sensor for detecting various reducing gases such as hydrogen sulfide, hydrogen, and fuel gases. The gas sensor device is coated with cuprous chloride material for detecting hydrogen sulfide. Thus, the Examiner concludes that it would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the gas sensor of Tamaki et al. for the electrochemcial gas sensor of De Castro et al. since both gas sensors are designed to detect a plurality of different gases that include hydrogen, and hydrogen sulfide gases to increase the detection functions of electrochemical gas sensors.

Applicants respectfully submit that the Examiner has misconstrued the Tamaki reference be believing that Tamaki teaches a sensor detecting various reducing gases. It appears that the Examiner's foundation for this position is due to a statement at Col. 1, lines 13 - 16, wherein prior art sensors are briefly mentioned. Tamaki clearly states at Col. 2, lines 42 - 43, that the gas which can be detected in the gas detecting portion is hydrogen sulfide gas.

The Applicants have amended claim 25 to include the limitation of claim 26. Further with respect to claims 6, 7, and 25 (as presently amended), Applicants submit that Tamaki et al. does not teach coating a sensor with copper chloride to increase the carbon monoxide sensitivity of the sensor. Rather, Tamaki teaches immersing the sensor in a mixed solution of a 0.05 mol/liter aqueous CuCl solution, a sensitizer, and a 1 mol/liter aqueous $CH_3CO_2NH_4$ solution at 30 °C for twenty four hours to fabricate a device

imparted with 5% by weight as CuO of a sensitizer that exhibits heightened sensitivity to high concentrations of hydrogen sulfide. See Col. 8, lines 1 - 60. Thus, Tamaki et al. teaches the use of copper chloride in a mixed solution to impart copper oxide on the sensor. Thus, the copper oxide is responsible for the high sensitivity to hydrogen sulfide at high concentration, and not the copper chloride as advanced by the Examiner. The Examiner has already acknowledged that De Castro fails to disclose the sensing material as cuprous chloride. The Applicants have demonstrated that the Tamaki reference not only fails to teach the detection of either carbon monoxide or hydrogen gas, but also fails to teach the use of copper chloride as the sensing material. Therefore, the combination of references cannot fairly be said to render claims 6, 7, and 25 an obvious variation of the prior art as the references fail to teach each and every element of the claimed invention.

CONCLUSION

In view of the foregoing amendment and accompanying remarks, the Applicants respectfully submit that the present application is properly in condition for allowance and may be passed to issuance upon payment of the appropriate fees.

Telephone inquiry to the undersigned in order to clarify or otherwise expedite prosecution of the subject application is respectfully encouraged.

Respectfully submitted,

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